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# Forest Insect and Disease Management

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BIOLOGICAL
EVALUATION R2-76-9

MOUNTAIN PINE BEETLE
COLORADO FRONT RANGE

Arapaho and Roosevelt,
Pike and San Isabel
National Forests
and
Adjacent Lands

NOVEMBER 1976

## Rocky Mountain Region

U.S. Department of Agriculture Forest Service

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## INTRODUCTION

The mountain pine beetle outbreak in ponderosa pine stands along the Front Range of Colorado was evaluated by Forest Insect and Disease Management personnel during the summer of 1976. This evaluation is the result of information collected primarily on Federal lands. The infestation on State and private lands is primarily the responsibility of the State of Colorado and is being evaluated by the State. Losses were found as far south as Westcliff and continued north to just beyond the State line, on the Medicine Bow National Forest and adjacent lands in Wyoming.

During the aerial evaluation survey it was estimated that over 660,000 ponderosa pine trees were infested in 1976 on about 280,000 acres of Federal lands in Colorado. The 1975 estimate was 600,000 trees on 250,000 acres of Federal land. The 1976 estimate for mountain pine beetle infested trees, based on 1:1 ratio, is over 1,000,000 trees on all ownerships in Colorado (Table 1).

## TECHNICAL INFORMATION

Casual Agent: *Dendroctonus ponderosae*, Hopk., mountain pine beetle.

Host: *Pinus ponderosa* Laws., ponderosa pine.

Type of Damage: Mortality is occurring in groups ranging from a few trees to groups of a few thousand trees. This tree mortality is generally found in overstocked stands of low vigor, although other stands may have some mortality due to site and tree conditions.

Life History: The mountain pine beetle has one generation per year. Adults attack trees from mid-July through early September by boring through the bark to the cambium. The females then tunnel upward for 12 inches to 30 inches (these tunnels are called egg galleries). The females lay eggs in individual niches along each side of the gallery which is then packed with frass. After hatching, the larvae feed in individual channels (larval galleries) at right angles to the egg galleries in the phloem. The insect overwinters in the larval stage. In the spring, when the larvae are fully developed, they excavate an oval chamber at the end of the larval gallery (pupal chamber) and pupate. Finally, mature adults emerge from the pupal chamber by boring through the outer bark and fly to attack new trees, completing the generation.

Biological Data: Brood samples were collected in June(1) utilizing Knight's sequential sampling technique(2) for mountain pine beetle in ponderosa pine. These samples showed the epidemic to be increasing.

After beetle flight, sample strips one-half chain wide or one-chain wide and approximately one-mile long were cruised in several locations to obtain ratios of 1976 infested trees to 1975 infested trees. This survey is summarized in Table 1 and shows a mean ratio of 1:.97 with a 90% confidence interval range of 1:1.08 to 1:.88. The procedure used for calculating the confidence intervals of the ratios is shown in Appendix A.

Data from Table 1 indicate the possibility of some interesting trends in the infestation. The build-up ratio for the entire Front Range is essentially 1:1 or approximately static. This is nevertheless a static infestation at an extremely high level and represents a tremendous amount of tree mortality. When the information from the build-up ratio survey lines is divided geographically into three groups, additional information is revealed. As shown in Table 1, the surveys were divided into three areas. The three areas and the number of lines within each one are: (1) from Buckhorn Canyon north to the Colorado - Wyoming state line (6 lines), (2) from Buckhorn Canyon south to west of Boulder (5 lines), (3) and the South Platte and Pikes Peak Ranger Districts of the Pike and San Isabel National Forests (6 lines). The northern area has a build-up ratio of 1:.81, the middle area has a build-up ratio of 1:1.02 and the southern area has a build-up ratio of 1:1.35. The average dbh of 1976 infested trees for the three areas are 8.29 for the northern area, 10.52 for the middle area, and 11.18 for the southern area. The lower average diameters of infested trees for the northern part of the Front Range might indicate that the infestation in that area is declining because of the reduction of suitable large diameter host trees needed to sustain an infestation. In the mid and southern portions of the Front Range this condition has not yet developed, and in the southern area of the Front Range the infestation is still increasing.

## DISCUSSION

Infested trees on National Forest and National Park lands that are within "Designated Control Areas" (DCA's) established by the State of Colorado have been chemically treated or logged. Suppression efforts on National Forest lands in the past years has consisted of logging of infested trees and silvicultural treatment of infested stands.

The direct suppression on Federal lands within "DCA's" was carried out primarily as a cooperative effort to support treatment efforts on private lands.

Chemical treatment and/or removal of beetle populations, at best, provide only temporary relief from epidemic losses. In most cases, long-term protection of ponderosa pine stands from mountain pine beetle epidemics must be accomplished through thinning of stands. Stands should be thined to a growing stock level of 80.[3] These stands will require periodic thinning to maintain a basal area of 80 sq. feet per acre.

Some stands, particularly at lower elevations of ponderosa pine growth, may occur on poor sites and will not attain a growing stock level of 80. For these stands thinning of smaller diameter trees will help prevent stand stagnation, but for larger diameter trees growing under these conditions, there is, at present, no satisfactory silvicultural treatment to prevent epidemics of the mountain pine beetle. However, on poor sites, growing stock level may have to be reduced further with emphasis placed on removing mature and overmature, damaged and dwarf mistletoe infected trees, which may be susceptible to beetle attack.

Dwarf mistletoe is another important factor for consideration in mountain pine beetle management. This disease weakens trees, and may make them more susceptible to attack. Concentrations of heavily mistletoed trees may provide epicenters for mountain pine beetle build-ups. Concentrations of heavily mistletoed trees should be harvested when applying silvicultural harvesting practices.

Chemical control is an alternative which may be used for protecting particularly high value trees. The only product registered in Colorado is "Pine Tree and Ornamental Spray"* and should be applied according to label directions prior to beetle flight.

## RECOMMENDATIONS

Chemical control or removal of infested trees provides immediate aesthetic relief in a given stand, but does not insure against recurring losses within the remaining stand. The only effective long-term method of preventing mountain pine beetle epidemics is through properly applied silvicultural practices. Wherever

*"Pine Tree and Ornamental Spray" is the only preventative spray registered in Colorado for use against mountain pine beetle. The spray is formulated by Balcom Chemical Inc., 240 22nd Street, Greeley, Colorado 80631.

possible, land managers should protect stands against the beetle by reducing the growing stock levels of their stands to 80. In order to effectively insure against future losses, stands must be kept at or below this growing stock level.

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3. MEYERS, C. A. Multipurpose Silviculture in Ponderosa Pine of the Montane Zone of Central Colorado. USDA, Forest Service, Rocky Mountain Forest and Range Experiment Station. Res. Paper RM-132, December 1974.

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## ACKNOWLEDGEMENT


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Wilmer Bailey - Forester, Aerial Survey

TABLE 1 STRIP CRUISE SURVEY BUILD-UP RATIO DATA
COLORADO FRONT RANGE 1976

| AREA | MILES OF LINE | 1976 INFESTED TREES NUMBER | 1976 INFESTED TREES AVERAGE DBH ± STAND ERROR | 1975 INFESTED TREES NUMBER | 1975 INFESTED TREES AVERAGE DBH ± STAND ERROR | BUILD-UP RATIO |
|---|---|---|---|---|---|---|
| Northern Front Range | .81 | 33 | 9.44 ± .32 | 5 | 11.20 ± .54 | 1 : 6.60 |
| Mill Creek | 1.25 | 76 | 7.31 ± .28 | 125 | 7.71 ± .23 | 1 : .61 |
| Praire Divide | 1.56 | 24 | 8.43 ± .54 | 53 | 9.62 ± .33 | 1 : .45 |
| Lady Moon Lake | 1.00 | 79 | 8.31 ± .20 | 14 | 8.29 ± .46 | 1 : 5.64 |
| Kelly Flats | 1.00 | 36 | 10.28 ± .43 | 34 | 10.62 ± .64 | 1 : 1.06 |
| Bear Mountain | .69 | 76 | 7.76 ± .37 | 167 | 7.11 ± .16 | 1 : .46 |
| | 6.31 | 324 | 8.29 ± .15 | 398 | 8.03 ± .14 | 1 : .81 |
| Middle Front Range | | | | | | |
| Buckhorn | .63 | 5 | 10.22 ± 3.29 | 33 | 8.98 ± .66 | 1 : .15 |
| Spruce Gulch | 1.06 | 47 | 10.22 ± .41 | 109 | 9.78 ± .20 | 1 : .43 |
| Johnny Park | 1.00 | 23 | 12.34 ± .74 | 5 | 9.82 ± .39 | 1 : 4.60 |
| Little James | 1.06 | 44 | 10.88 ± .71 | 9 | 11.28 ± 1.67 | 1 : 4.89 |
| Magnolia | 1.00 | 104 | 10.12 ± .36 | 62 | 9.32 ± .27 | 1 : 1.68 |
| | 4.75 | 223 | 10.52 ± .26 | 218 | 9.59 ± .18 | 1 : 1.02 |
| Southern Front Range | | | | | | |
| Bailey | 2.13 | 70 | 10.79 ± .36 | 17 | 10.83 ± .72 | 1 : 4.12 |
| Indian Creek | .75 | 41 | 12.54 ± .64 | 23 | 9.80 ± .72 | 1 : 1.78 |
| Scraggy Peaks | 2.10 | 17 | 11.24 ± .71 | 36 | 12.52 ± .62 | 1 : .47 |
| S. Gabor | 2.00 | 20 | 8.47 ± .48 | 35 | 9.80 ± .44 | 1 : .57 |
| Rainbow Falls | 1.06 | 30 | 11.41 ± .78 | 13 | 14.16 ± 1.22 | 1 : 1.08 |
| Red Rock | .88 | 6 | 14.13 ± 1.01 | 12 | 12.75 ± .91 | 1 : .50 |
| | 8.92 | 184 | 11.18 ± .27 | 136 | 11.33 ± .31 | 1 : 1.35 |
| Total Front Range | 19.98 | 731 | 9.70 ± .13 | 752 | 9.08 ± .11 | 1 : .97 |

90% CONFIDENCE INTERVALS FOR BUILD-UP RATIOS

| AREA | MEAN ESTIMATE | HIGH ESTIMATE | LOW ESTIMATE |
|---|---|---|---|
| Northern Front Range | 1 : .82 | 1 : .94 | 1 : .70 |
| Middle Front Range | 1 : 1.02 | 1 : 1.24 | 1 : .85 |
| Southern Front Range | 1 : 1.35 | 1 : 1.70 | 1 : 1.09 |
| Total Front Range | 1 : .97 | 1 : 1.08 | 1 : .88 |

FIGURE 1

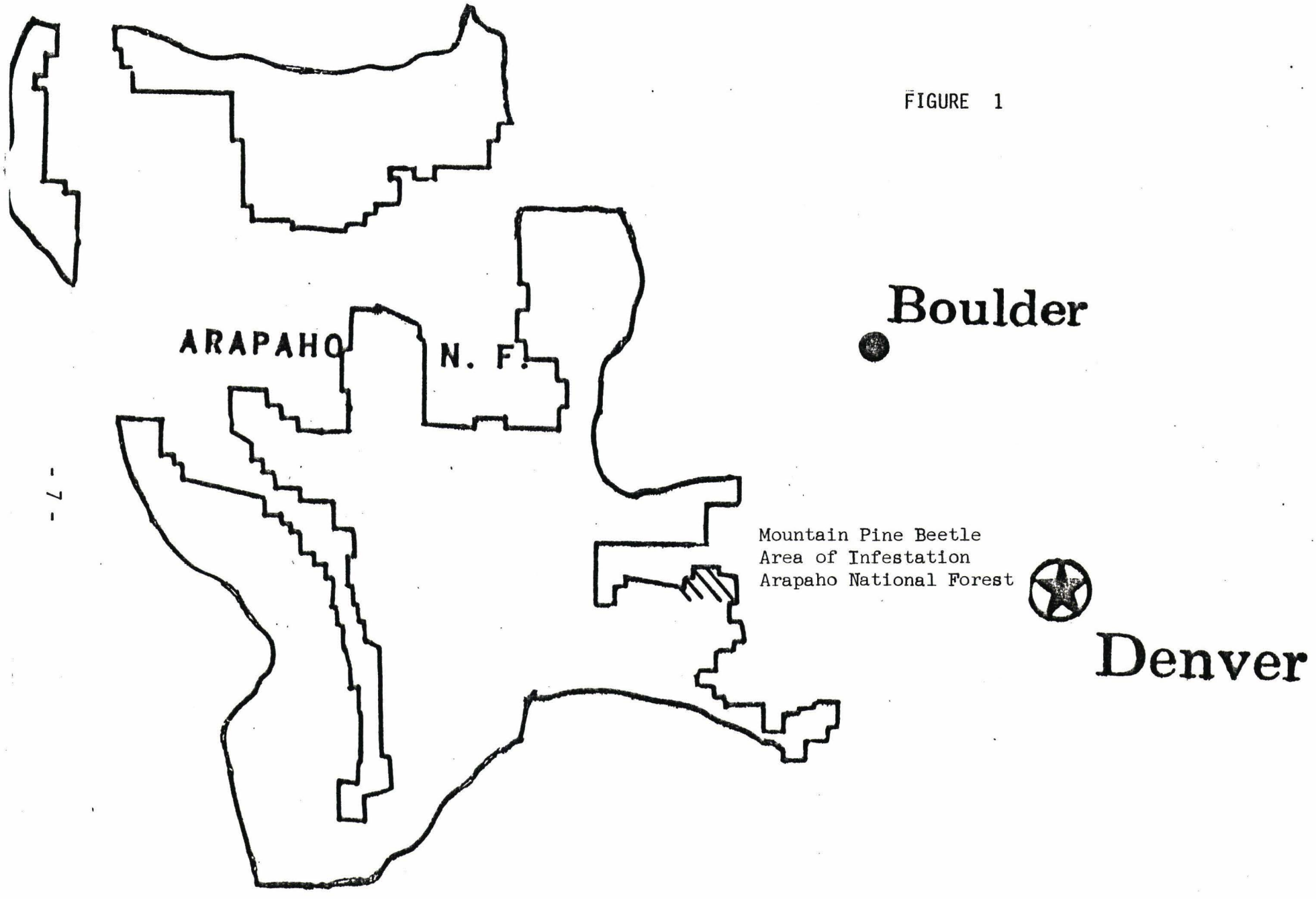

ARAPAHO N. F.
Boulder
Mountain Pine Beetle
Area of Infestation
Arapaho National Forest
Denver

FIGURE 2

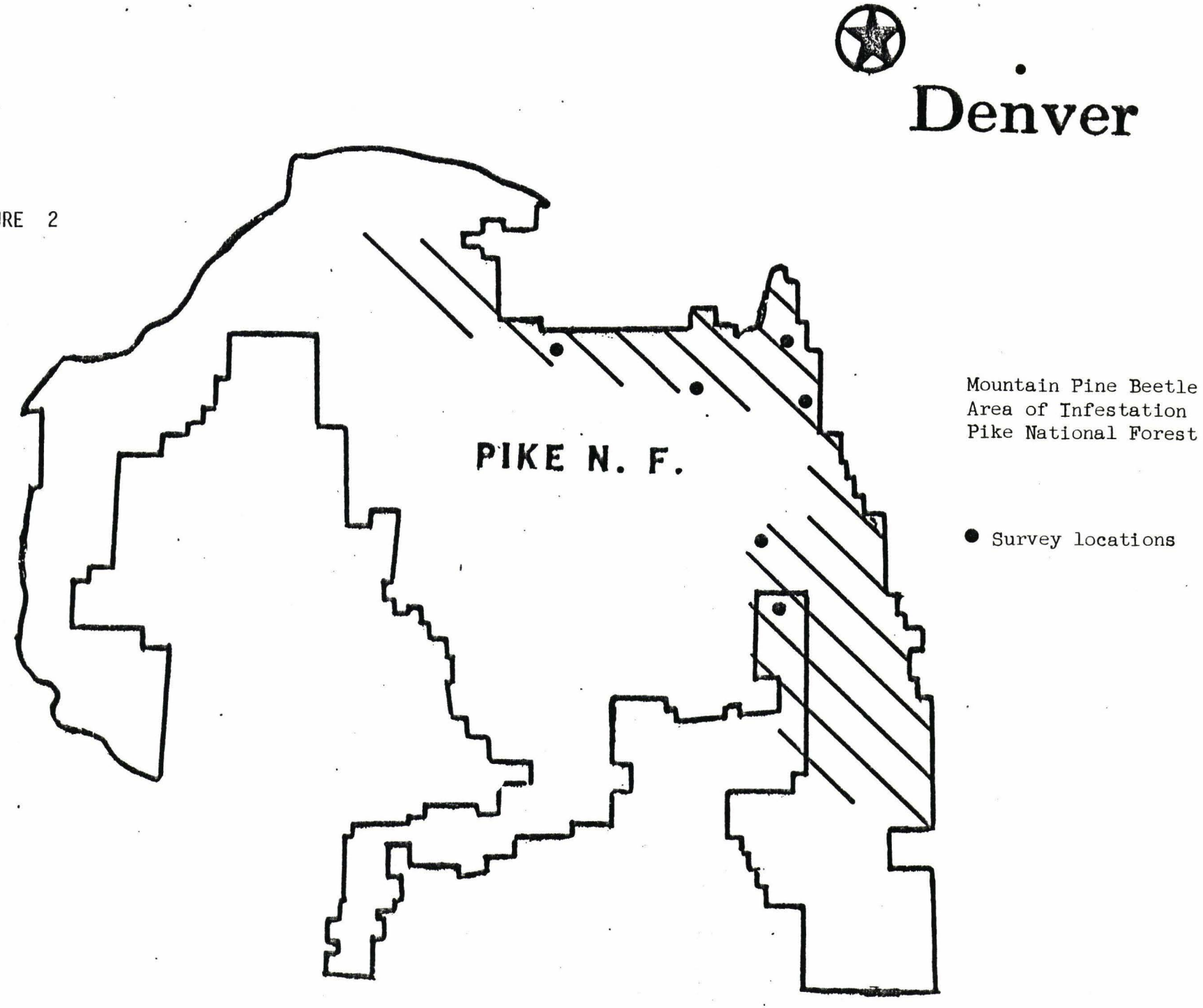

Denver
PIKE N. F.
Mountain Pine Beetle
Area of Infestation
Pike National Forest
Survey locations

FIGURE 3

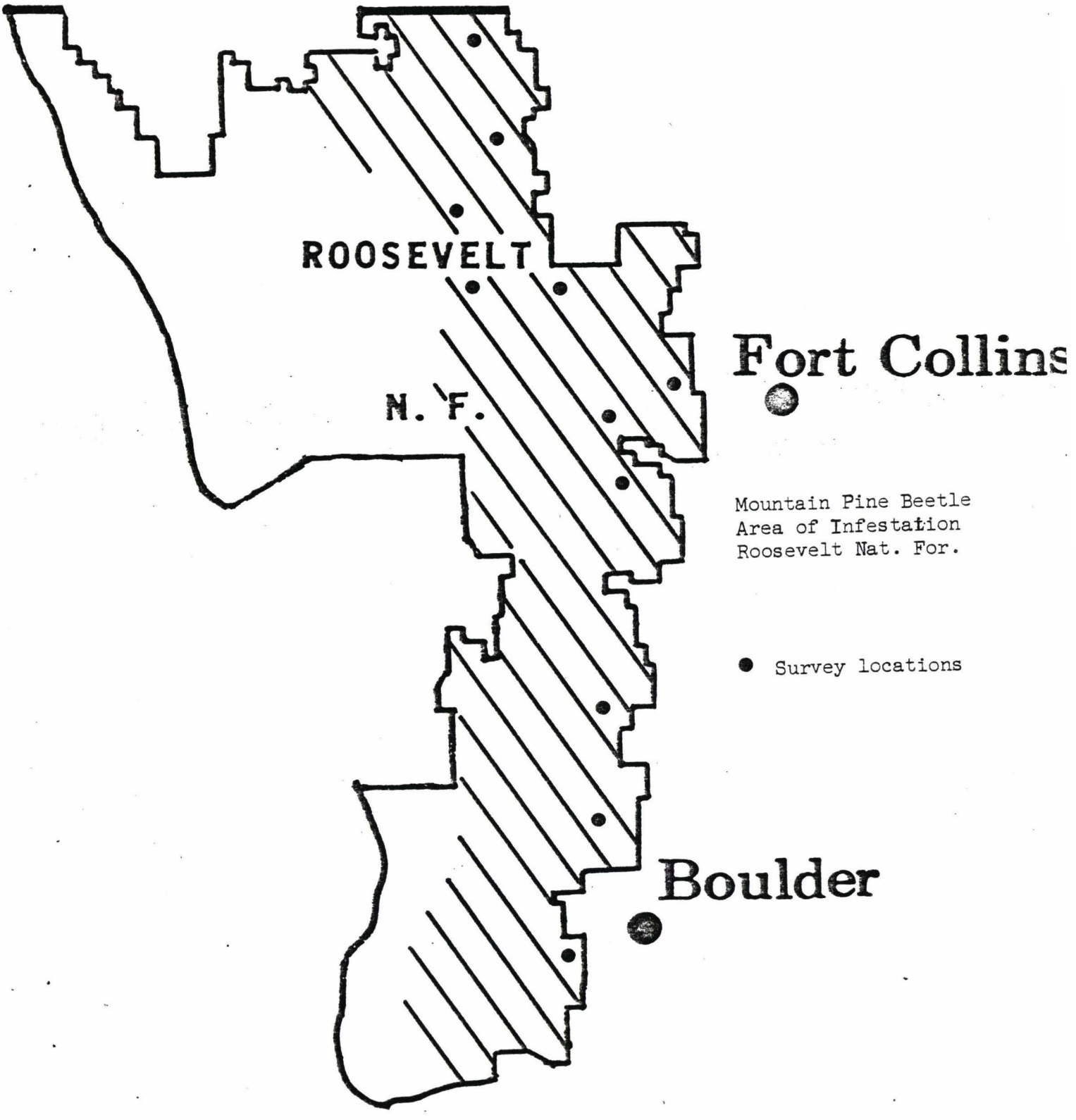
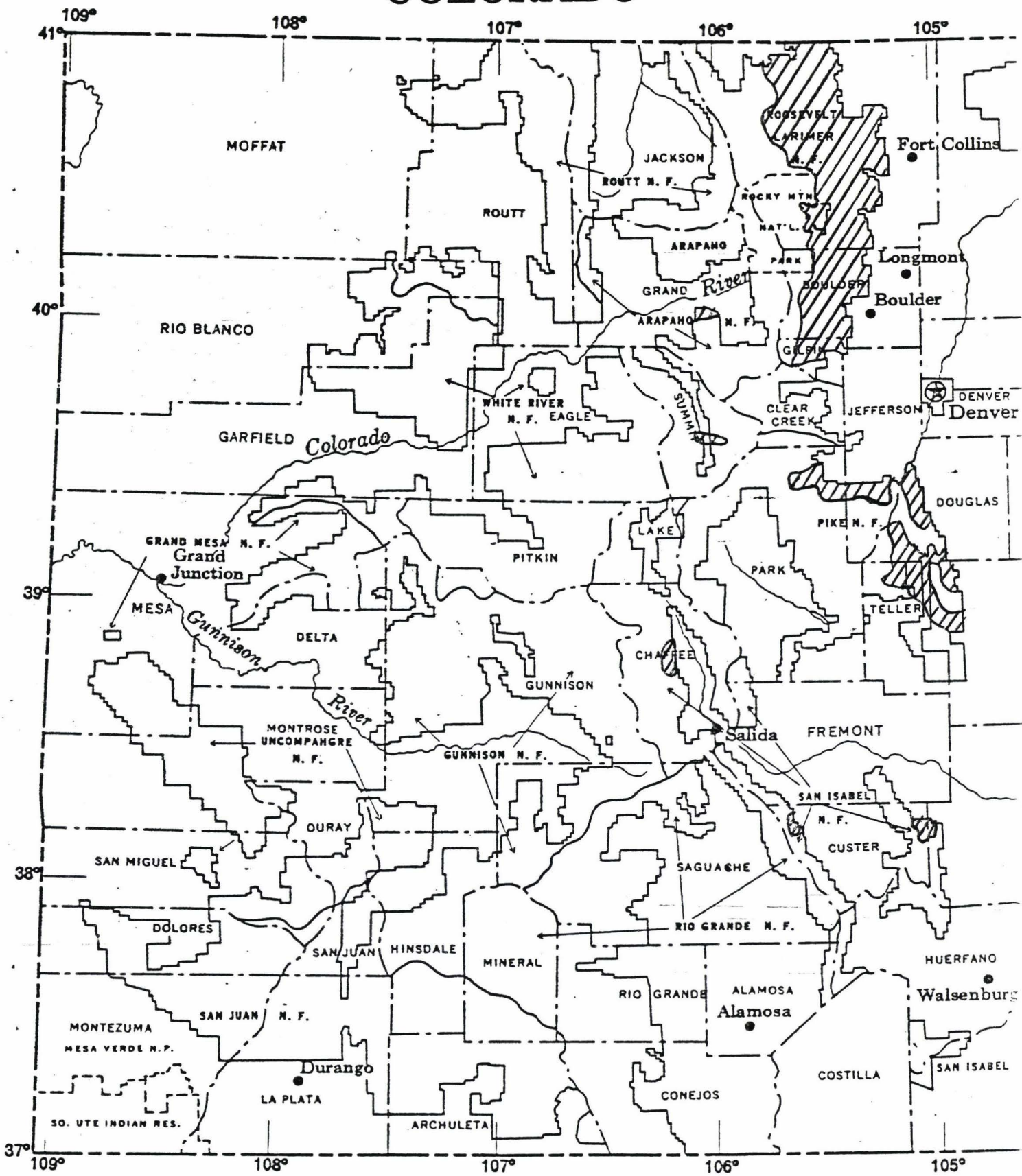

ROOSEVELT
N. F.
Fort Collins
Boulder
Mountain Pine Beetle
Area of Infestation
Roosevelt Nat. For.
Survey locations

FIGURE 4

# COLORADO




MOUNTAIN PINE BEETLE INFESTATIONS IN COLORADO

APPENDIX A. CALCULATION OF CONFIDENCE INTERVALS FOR BUILD-UP RATIOS [4]

Given: The population of interest consists of mountain pine beetle infested trees. This population consists of two classes: (1) Trees infested in 1976, (2) trees infested in 1975. Confidence intervals for the build-up ratio estimate are computed as follows:

A = Number of trees infested in 1976 counted in a given area
B = Number of trees infested in 1975 counted in a given area
N = A + B = Total of 1975 & 1976 infested trees counted in a given area

$p = \frac{A}{B}$ = proportion of total trees counted which were infested in 1976

$q = \frac{B}{N}$ = proportion of total trees counted which were infested in 1975

C. I. = Confidence Interval

Example: For the total Front Range build-up ratio
A = 731 B = 752 N = A + B = 1483

$p = \frac{A}{N} = \frac{731}{1483} = .493$ $q = \frac{B}{N} = \frac{752}{1483} = .507$

90% C. I. for q is: $q \pm 1.96\sqrt{\frac{pq}{N}} = .507 \pm 1.96\sqrt{\frac{.493 \times .507}{1483}} = .507 \pm .025$

High and low estimate of q = $.507 \pm .025$ = .532 to .482

For build-up ratio purposes make q = 1

Then: mean estimate = $.507 : \frac{.493}{.507} = 1 : .97$

90% C. I. expressed as $.532 : \frac{.468}{.532} = 1 : .88$ and $.482 : \frac{.518}{.482} = 1 : 1.07$

Build-up ratio with 90% C. I. is: mean estimate = 1.97 Range = 1 : .88 to 1 : 1.07

# PESTICIDE USE STATEMENT

Pesticides used improperly can be injurious to man, animals, and plants. Follow the directions and heed all precautions on the labels.

Store pesticides in original containers under lock and key -- out of the reach of children and animals -- and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides when there is danger of drift, when honey bees or other pollinating insects are visiting plants, or in ways that may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment if specified on the container.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

Do not clean spray equipment or dump excess spray material near ponds, streams, or wells. Because it is difficult to remove all traces of herbicides from equipment, do not use the same equipment for insecticides or fungicides that you use for herbicides.

Dispose of empty pesticide containers promptly. Have them buried at a sanitary land-fill dump, or crush and bury them in a level, isolated place.

NOTE: Some States have restrictions on the use of certain pesticides. Check your State and local regulations. Also, because registrations of pesticides are under constant review by the U. S. Department of Agriculture, consult your county agricultural agent or State Extension specialist to be sure the intended use is still registered.